IMPACT OF SOCIAL ISOLATION ON FEMALE *DROSOPHILA* POSITION

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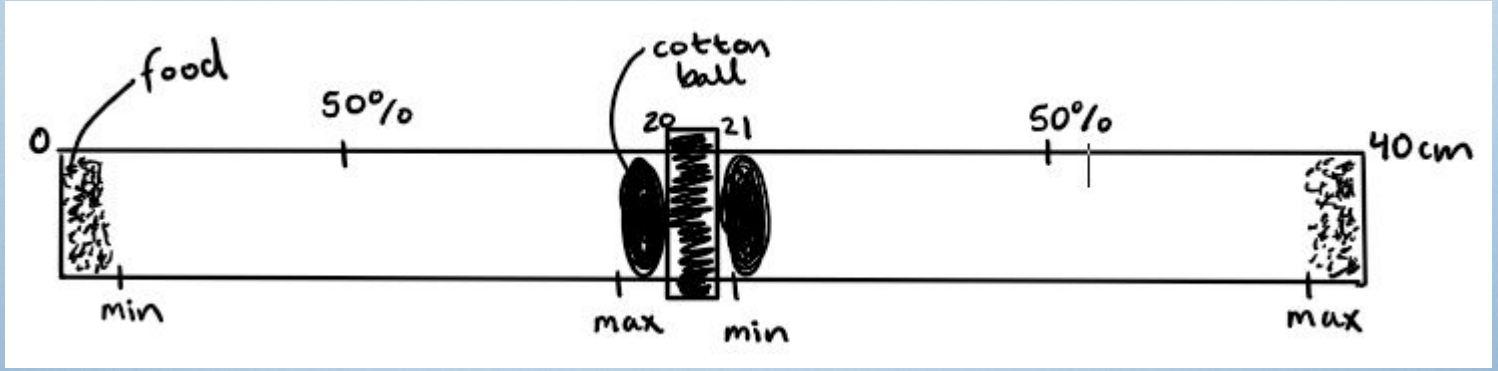
BACKGROUND

- Used unpublished dataset collected by Dr. Drew Stenesen, Ph.D.
- Experiment:
    - Used *Drosophila melanogaster* - specifically CantonS flies (wild type population from Canton, OH).
    - ~ 15 males and 15 females allowed to lay eggs until pupation (larvae form hard casing called puparium and undergo metamorphosis).
    - All pupae isolated in a vial until eclosion (adult flies emerge from pupal cases).
    - Virgin females isolated:
        - **Control group (CantonS_group)**: ~ 25 flies grouped for 7 days
        - **Experimental group (CantonS_indiv)**: ~ 25 flies isolated individually for 7 days

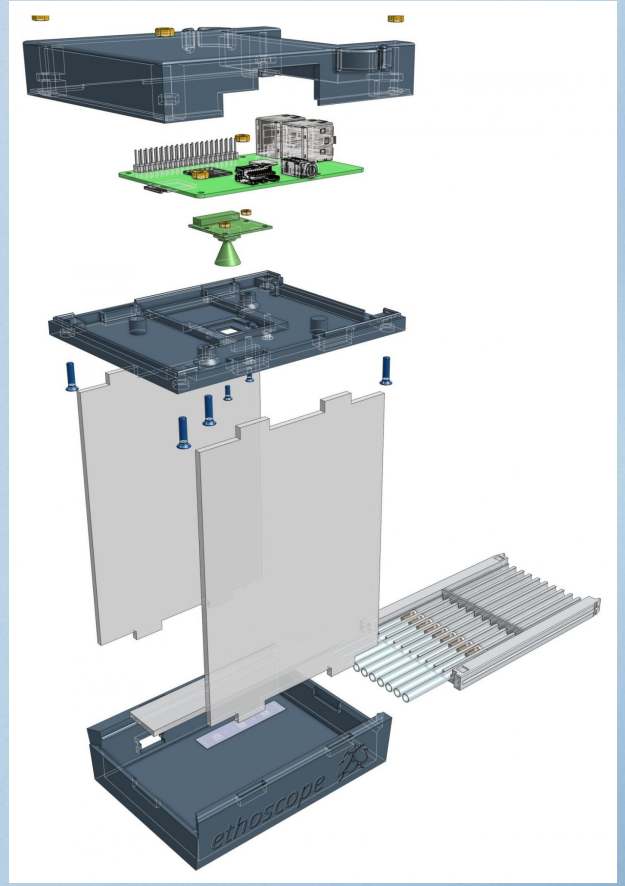
BACKGROUND

- Experiment (Cont):
  - One fly per capillary tube (20 tubes per ethoscope arena).
  - Maintained under similar environmental conditions: same food, 25℃ incubator at constant humidity, and 12/12 light/dark cycle.



BACKGROUND

- Flies acclimated for ~ 24 hours.
- Data collection started on Day 8 and spanned across 5 days.
- Used **ethoscopes**:
    - Raspberry pi: equipped with infrared camera - measures position 3 times per second along 20 cm capillary tube.
    - 2 ethoscopes with CantonS_group flies, 1 with CantonS_indiv, 1 with CantonS_H2O (starved flies; excluded in this data analysis).



QUESTION

DOES SOCIAL ISOLATION HAVE A SIGNIFICANT EFFECT ON FEMALE DROSOPHILA POSITION DURING THE DAY VS. THE NIGHT?

HYPOTHESES

NULL HYPOTHESIS

Social isolation **does not have** a significant effect on female Drosophila position during the day vs. the night.

ALTERNATIVE HYPOTHESIS

Social isolation **does have** a significant effect on female Drosophila position during the day vs. the night.

Descriptive Statistics of Tube Occupancy (Day 1–5)

CantonS_indiv = isolated since birth | CantonS_group = socially reared → isolated during assay

Genotype	Day	Light/Dark	Mean (cm)	Median (cm)	SD	SEM	Min	Max	N
CantonS_group	1	Dark	9.62	8.90	5.59	0.01	0.15	19.96	168100
CantonS_group	1	Light	10.84	11.14	5.82	0.01	0.26	19.96	168341
CantonS_group	2	Dark	9.53	8.26	5.97	0.01	0.04	19.96	167807
CantonS_group	2	Light	10.85	11.21	6.15	0.01	0.04	19.96	168157
CantonS_group	3	Dark	10.30	9.74	6.40	0.02	0.07	19.96	166991
CantonS_group	3	Light	11.08	11.94	6.35	0.02	0.07	19.96	167520
CantonS_group	4	Dark	9.43	8.53	6.32	0.02	0.07	19.96	161685
CantonS_group	4	Light	11.13	12.12	6.26	0.02	0.07	19.96	167460
CantonS_group	5	Light	9.60	9.89	6.13	1.07	0.37	19.17	33
CantonS_indiv	1	Dark	11.28	12.07	4.57	0.02	0.89	19.89	86183
CantonS_indiv	1	Light	10.49	10.28	5.44	0.02	0.07	19.89	86290
CantonS_indiv	2	Dark	11.93	13.03	4.76	0.02	0.92	19.89	85854
CantonS_indiv	2	Light	10.75	10.76	5.98	0.02	1.00	19.93	86358
CantonS_indiv	3	Dark	12.38	13.76	4.93	0.02	0.96	19.93	81778
CantonS_indiv	3	Light	10.47	10.18	6.29	0.02	0.96	19.96	83048
CantonS_indiv	4	Dark	12.02	13.54	5.34	0.02	0.96	19.93	81262
CantonS_indiv	4	Light	10.72	10.83	6.36	0.02	0.96	19.93	81983
CantonS_indiv	5	Light	8.35	7.03	5.92	1.36	1.29	18.86	19

DESCRIPTIVE STATISTICS

- For CantonS_group, mean position along capillary tube during the “day” (light) was always **more than** the mean position during the “night” (dark) for each day.
- For CantonS_indiv, mean position along capillary tube during the “day” (light) was always **less than** the mean position during the “night (dark) for each day.

FIGURE #1: BAR GRAPH OF AVERAGE FLY POSITION ALONG 20 CM TUBE

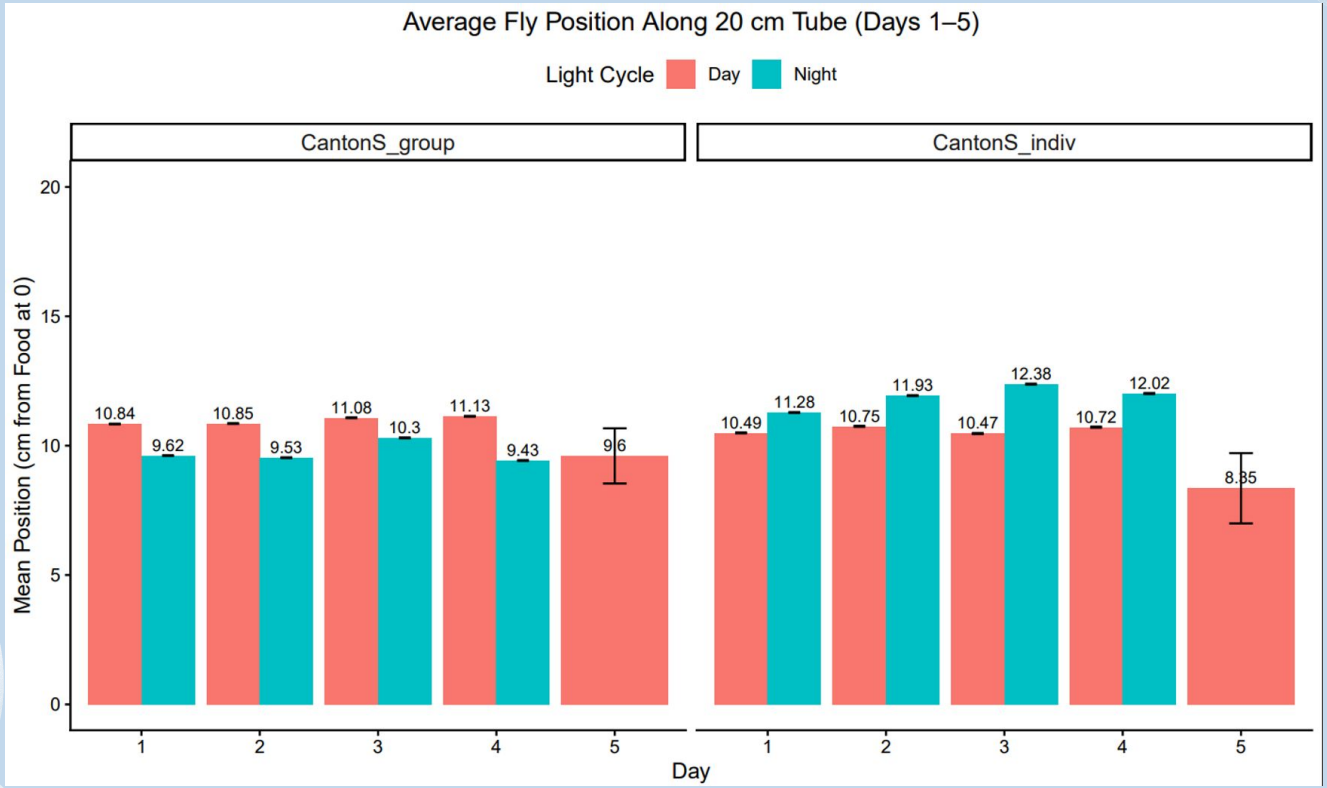


FIGURE #2: RIDGELINE GRAPH OF FLY POSITION DISTRIBUTION

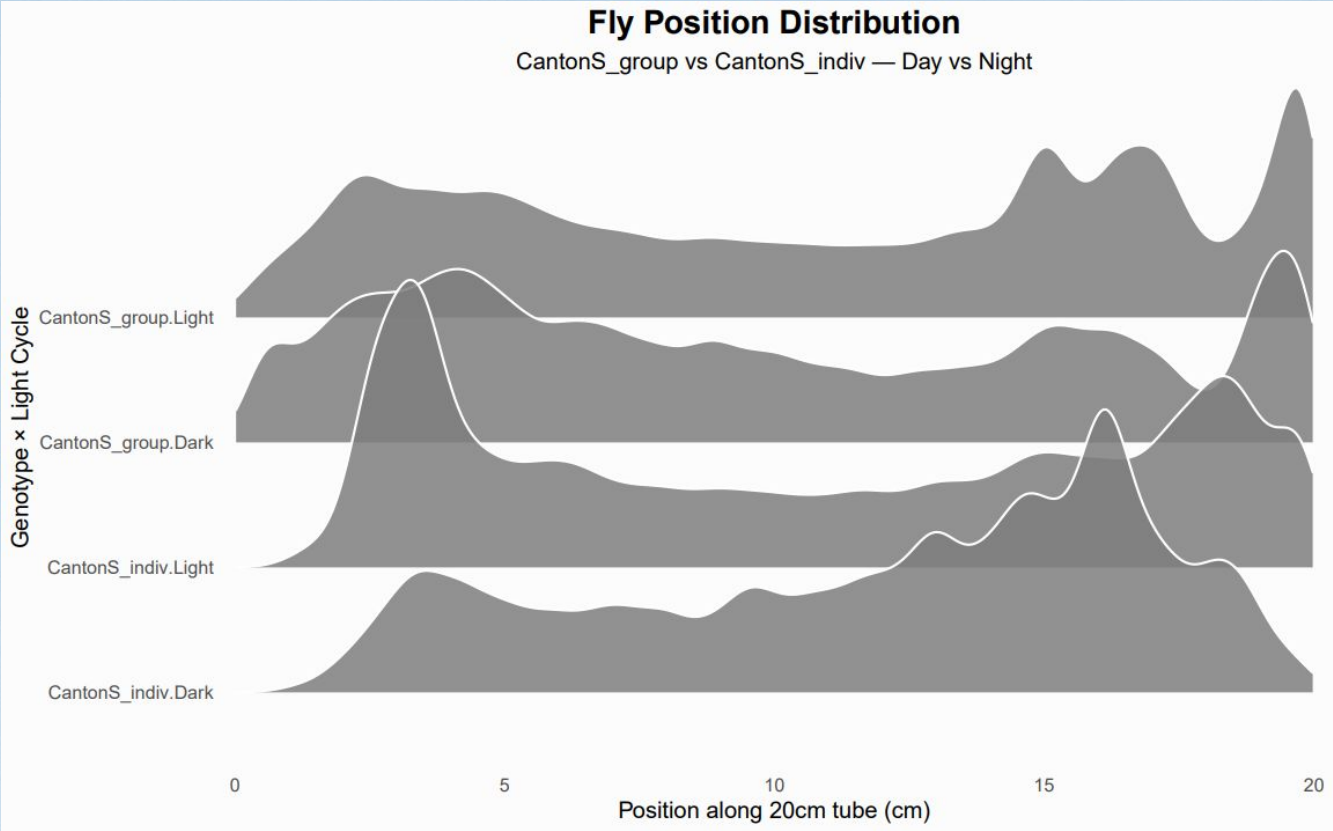


FIGURE #3: HISTOGRAM OF FLY OCCUPANCY ALONG TUBE

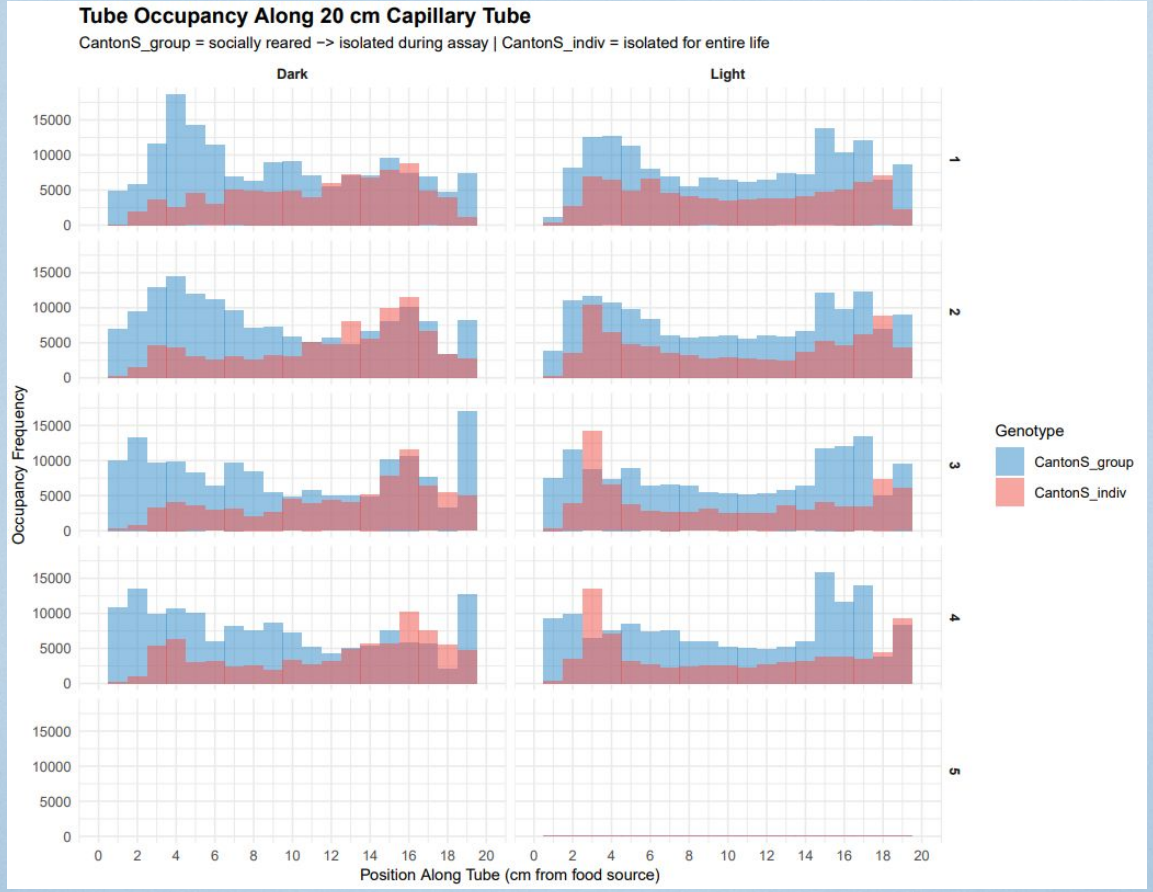


FIGURE #4: HEATMAP OF CANTONS_GROUP POSITION (0 CM = FOOD END

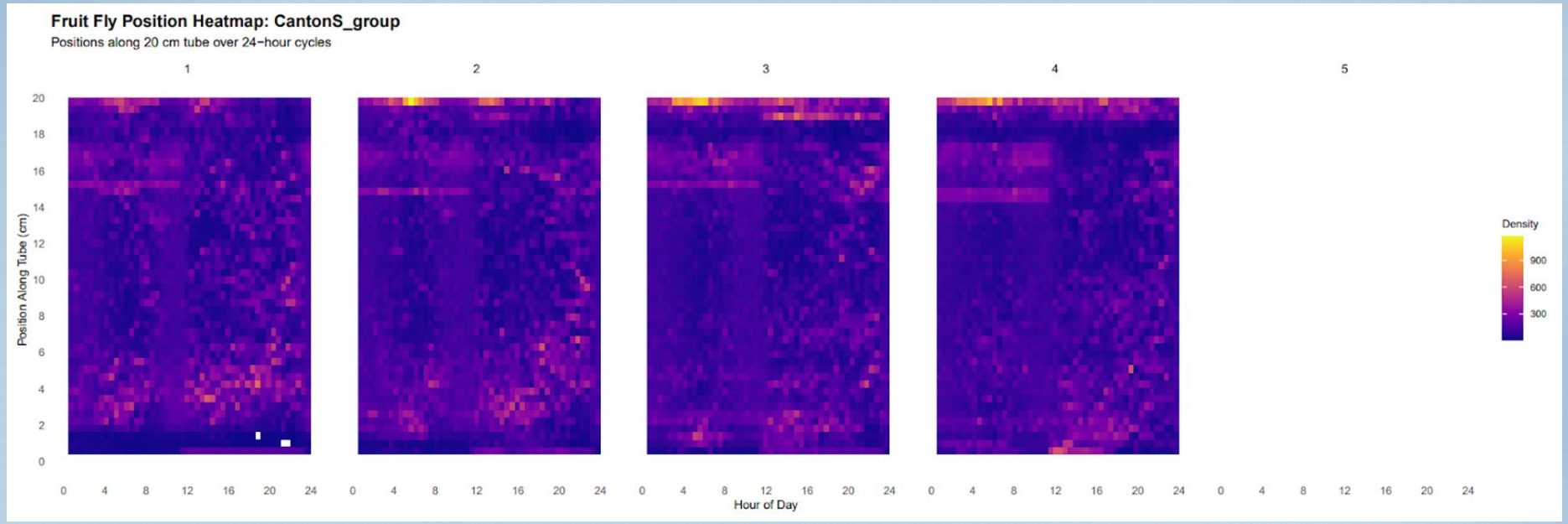
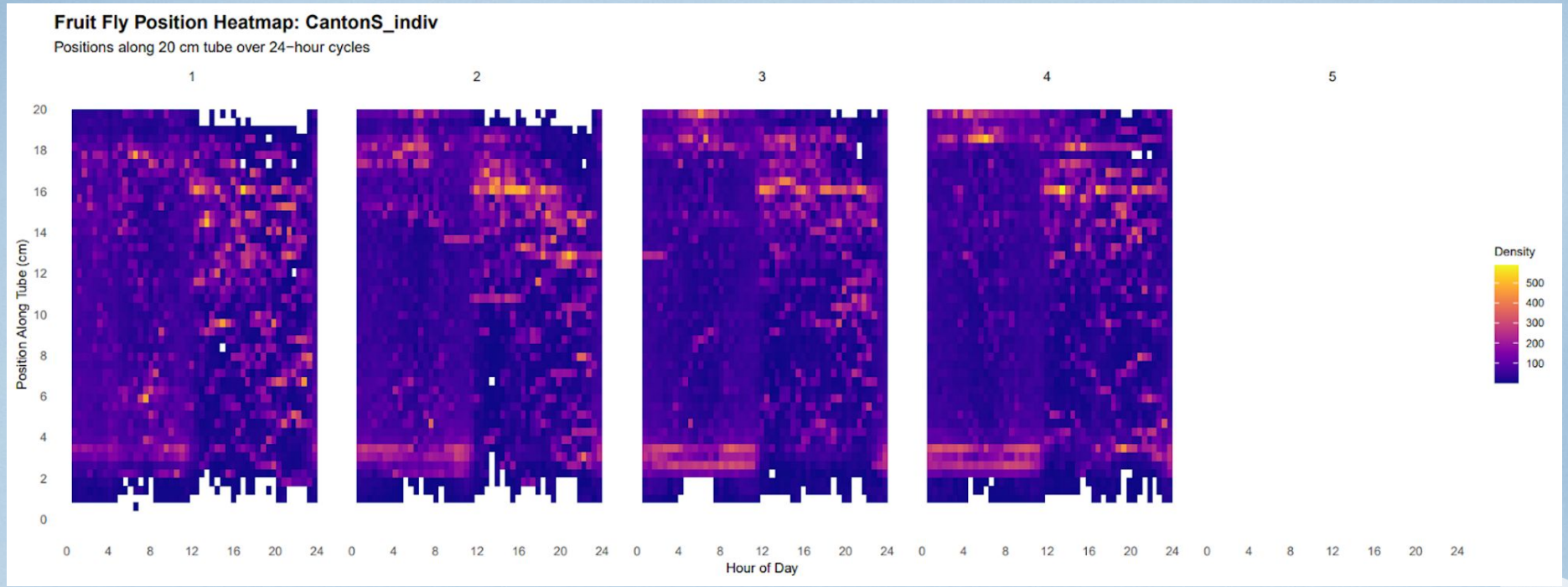


FIGURE #5: HEATMAP OF CANTONS_INDIV POSITION (0 CM = FOOD END



TRENDS

POSITION

Flies seem to mostly spend time near the ends of the capillary tube, rather than in the middle.

LIGHT/DARK

- Light: CantonS_indiv spent more time closer to the food end (0 cm).
- Dark: CantonS_indiv spent more time closer to the opposite end (20 cm).

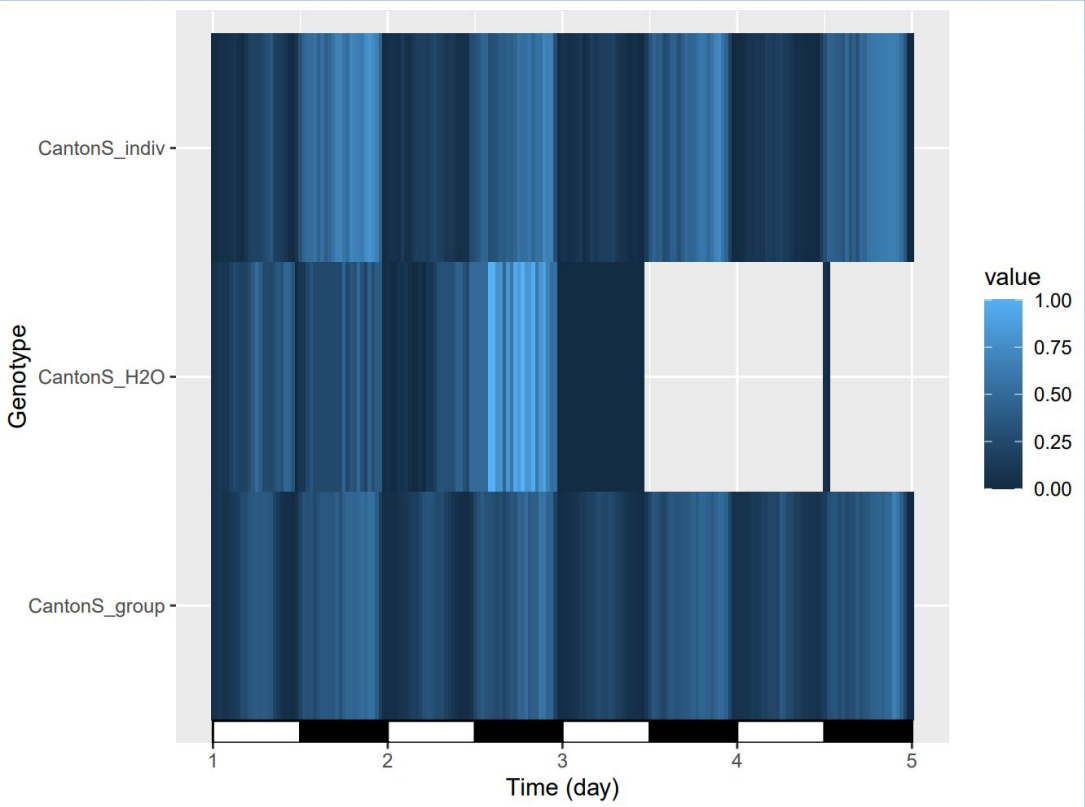
CANTONS_GROUP

Positioning a little more scattered among the population.

CANTONS_INDIV

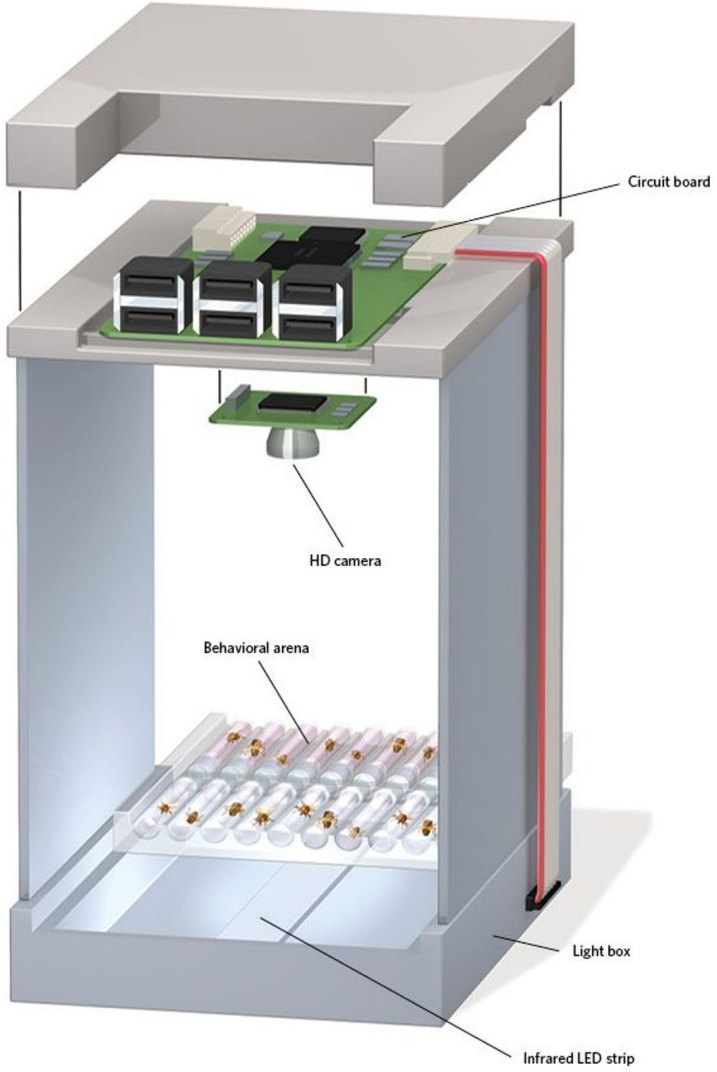
Positioning a little more clustered among the population - more flies were at the same location at the same point in time more often.

FIGURE #6: TILE PLOT OF FLY SLEEP (1.00 = 100% OF POPULATION IS ASLEEP)



DISCUSSIONS

- CantonS_group flies had more dark blue and purple on the heat map → positioning more scattered → more sporadic behavior due to being isolated for the first time in their lives?
- CantonS_indiv flies had more orange and yellow on the heat map → more flies had same positioning → seeing other flies for the first time and want to follow each other's movements? (walls cover bottom half of capillary tubes).
- More CantonS_indiv flies spend more time near the food end during the day, but during their afternoon nap (according to sleep tile plot), seem to move to the opposite end → sleep away from food?
- CantonS_group flies don't seem to have the same behaviors as CantonS_indiv.



ANOVA: TWO FACTOR WITH REPLICATION

- Pr(>F): p-value associated with F-statistic.
- Chosen significance level: 0.05
- **P-value for Genotype**: < 2.2e-16
- **P-value for Day/Night**: < 2.2e-16
- **P-value for Genotype:Day/Night**: < 2.2e-16
- P-value < 0.05 → statistically significant:
  - **Genotype**: CantonS_indiv and CantonS_group flies differ in overall position.
  - **Day/Night**: Flies position themselves differently during the day vs. night.
  - **Genotype:Day/Night**: Effect of social isolation depends on day/night

	Df	Sum Sq	Mean Sq	F value
Genotype	1	361817	361817	10250
DayNight	1	81995	81995	2323
Genotype:DayNight	1	728327	728327	20634
Residuals	2008813	70906580	35	
	Pr(>F)			
Genotype	<2e-16 ***			
DayNight	<2e-16 ***			
Genotype:DayNight	<2e-16 ***			
Residuals				

Signif. codes:
0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

CONCLUSION

Social isolation **DOES** significantly affect female Drosophila position during the day vs. the night. The results unlikely to have occurred by random chance alone.

FUTURE WORK

REPLICATION

Only 1 trial was conducted for this experiment - should replicate to see if results are consistent.

MALE FLIES

Run the experiment with male flies instead of female flies to see if there is a difference in behavior based on sex.

MOVEMENT

Instead of just solely looking at fly position, want to factor in velocity. Do flies speed up or slow down around food, depending on the time of day, or before and after sleep? Could give more insight into the scattered positioning of CantonS_group flies.

THANKS!